IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

***In re* Patent Application of:** **Docket No.:** 61610070US

Yong-Tae KIM

Serial No.: 10/664,157 **Group Art Unit:** 1745

Confirmation No.: 4172

Filed: September 17, 2003 **Examiner:** Helen CHU

For: **NEGATIVE ELECTRODE FOR LITHIUM BATTERY AND LITHIUM BATTERY COMPRISING THE SAME**

Mail Stop: Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPELLANTS' BRIEF ON APPEAL

Sir:

This is an appeal from the final rejection of all pending claims in this application, specifically, claims 1-19 and 21-25. The fee for the Appeal Brief has been submitted herewith. If further fees are due upon filing of this Brief on Appeal, please charge such fees or credit any overpayment to **Deposit Account No. 50-3698 (H. C. Park & Associates, PLC)**.

The Notice of Appeal was filed on June 18, 2007 with the United States Patent & Trademark Office ("USPTO") along with a Pre-Appeal Brief Request for Review. The Notice of Panel Decision from Pre-Appeal Brief Review was mailed on July 16, 2007. Accordingly, Appellants' Brief on Appeal is timely filed on or before August 18, 2007.

In response to the Final Office Action mailed March 16, 2007 ("Office Action") and the Advisory Action mailed June 12, 2007 ("Advisory Action"), Appellants submit that the rejections of record are not proper and are without basis.

(i) IDENTIFICATION OF REAL PARTY IN INTEREST

The real party in interest is Samsung SDI Co., Ltd., which is the assignee of record of the present application and is a publicly traded company organized and existing under the laws of the Republic of Korea.

(ii) RELATED APPEALS AND INTERFERENCES

Upon information and belief of undersigned counsel, appellants and the assignee of record are not aware of any pending appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

(iii) STATUS OF CLAIMS

Claims 1-19 and 21-25 have been rejected and are being appealed.

Claims 26-38 have been withdrawn from consideration.

No claims have been allowed in this application.

(iv) STATUS OF AMENDMENTS

No amendments have been filed subsequent to final rejection.

(v) SUMMARY OF CLAIMED SUBJECT MATTER

Claims 1 and 24 are independent claims. Claims 2-19 and 21-23 each depend from claim 1 and claim 25 depends from claim 24. The independent claims and the dependent claims on appeal are directed to a negative electrode for a lithium battery.

The negative electrode for a lithium battery of claim 1 includes a lithium metal layer 20 and a protective layer 30 on the lithium metal layer 20, wherein the protective layer 30 includes an organosulfur compound (see Figure 1 and page 6, lines 3-7 of the specification) and an ionic

conductive polymer to help facilitate transfer of lithium ions (see page 10, lines 8-10 of the specification).

The negative electrode for a lithium battery of claim 24 includes a lithium metal layer 20 and a protective layer 30 on the lithium metal layer 20, wherein the protective layer 30 includes an organosulfur compound (see Figure 1 and page 6, lines 3-7 of the specification), an electron conductive polymer (see column 7, lines 12-13 of the specification), and an ionic conductive polymer (see page 10, lines 8-10 of the specification).

<u>(vi) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL</u>

In the Office Action, claims 1-7, 9-17, and 19-24 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,961,672 issued to Skotheim, *et al.* ("Skotheim") in view of U.S. Patent No. 6,245,458 issued to Sotomura ("Sotomura"), claims 8 and 18 were rejected under 35 U.S.C. §103(a) as being unpatentable over Skotheim in view of Sotomura in further view of JP Publication 10-101793 to Zuiho *et al*. ("Zuiho"), and claims 24 and 25 were rejected under 35 U.S.C. §103(a) as being unpatentable over Skotheim in view of Sotomura in further view of U.S. Patent 5,523,179 issued to Chu ("Chu") and U.S. Patent 6,030,719 issued to Fauteux *et al*. ("Fauteux").

The issue on appeal is whether the Examiner established a *prima facie* case of obviousness in rejecting claims 1-7, 9-17, and 19-24 under 35 U.S.C. §103(a) as obvious over Skotheim in view of Sotomura, whether claims 8 and 18 are unpatentable over Skotheim in view of Sotomura in further view of Fauteux, and whether the Examiner established a *prima facie* case of obviousness in rejecting claims 24 and 25 under 35 U.S.C. §103(a) as obvious over Skotheim in view of Sotomura in further view of Chu and Fauteux.

(vii) ARGUMENT

SUMMARY OF ARGUMENT

A *prima facie* case of obviousness has not been established to support a rejection of the claims under 35 U.S.C. §103. First, there is no reason, either in or outside of the cited references, for one of ordinary skill in the art to combine or modify the cited references. Second, the cited references fail to teach or suggest all of the claimed features. Therefore, the pending rejections should be withdrawn and the claims should be allowed to issue.

THE LEGAL STANDARD

A rejection of claims under 35 U.S.C. §103 cannot stand where the examiner has failed to establish a *prima facie* case of obviousness.[1] In the absence of a *prima facie* case of obviousness, an applicant who complies with the other statutory requirements is entitled to a patent.[2]

To establish an obviousness rejection under 35 U.S.C. § 103(a), four factual inquiries must be examined. The four factual inquiries include (a) determining the scope and contents of the prior art; (b) ascertaining the differences between the prior art and the claims in issue; (c) resolving the level of ordinary skill in the pertinent art; and (d) evaluating evidence of secondary consideration.[3] In view of these four factors, the analysis supporting a rejection under 35 U.S.C. 103(a) should be made explicit, and should "identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the [prior art] elements" in the manner claimed.[4] Furthermore, even if the prior art may be combined in the manner claimed, there

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[1] *In re Deuel*, 51 F.3d 1552, 1557, 34 USPQ2d 1210, 1214 (Fed. Cir. 1995).
[2] *In re Oetiker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992).
[3] *Graham v. John Deere*, 383 U.S. I, 17-18 (1966).
[4] *KSR Int'l. Co. v. Telefex, Inc.*, 550 U.S. __, slip op. at 14-15 (2007).

must be a reasonable expectation of success, and the reference or references, when combined, must disclose or suggest all of the claim limitations.[5]

Finally, a conclusion of obviousness is evaluated not only with respect to whether the examiner has met his burden of establishing a *prima facie* case of obviousness, but also with respect to whether rebuttal evidence has been evaluated fully and fairly.[6]

In this case, insufficient support exists to establish a *prima facie* case of obviousness. Therefore, the rejections of the pending claims under 35 U.S.C. 103 should be withdrawn.

1. THE EXAMINER HAS FAILED TO IDENTIFY A REASON THAT WOULD HAVE PROMPTED A PERSON OF ORDINARY SKILL IN THE ART TO COMBINE THE REFERENCES IN THE MANNER CLAIMED

One of ordinary skill in the art faced with the problem presented in Skotheim would not look to the teaching of Sotomura because the references address completely different problems. Skotheim is directed at providing a lithium metal anode that has been stabilized against dendrite formation, whereas Sotomura is directed at providing a cathode electrode composition containing an organic sulfide compound.

In the Advisory Action, the Examiner asserts that "the Sotomura reference teaches an organo-sulfur composite electrode capable of being doped electrically with lithium ions and teaches that the composite layer exhibits high energy density and gives a high charging and discharging efficiency and good charging and discharging cycle lift which provides motivation to combine the organosulfur composite into the anode as taught by Skotheim."

However, this statement fails to provide a reason why one of ordinary skill would combine a teaching regarding a cathode electrode, which does not include a lithium metal layer,

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[5] See *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).
[6] *In re Piasecki*, 745 F.2d 1468, 1470-73, 223 USPQ 785, 787-88 (Fed. Cir. 1984).

and a teaching regarding an anode electrode, which does include a lithium metal layer, into a single electrode. It is again noted that an electrode doped with lithium ions does not include a lithium metal layer.

2. THE COMBINED REFERENCES FAIL TO DISCLOSE OR SUGGEST ALL OF THE CLAIM LIMITATIONS

The Office Action does not establish a *prima facie* case of obviousness because the combined references fail to disclose all of the claimed features.

The combined references fail to disclose an organosulfur compound in a negative electrode for a lithium battery, as required by claims 1 and 24. Skotheim discloses a secondary battery including a composite lithium anode and a thin film of lithium ion-conductive polymer interposed between the lithium metal and the electrolyte. However, Skotheim fails to disclose a protective layer including an organosulfur compound and an ionic conductive polymer.

The Examiner relies on Sotomura to cure this deficiency in Skotheim. Sotomura teaches an electrode composite including an organosulfur compound and a polymer electrolyte (see column 4, line, 15 and column 5, lines 43-58). However, this electrode composite does not include a lithium metal layer and is used as the cathode electrode, not as the anode electrode (see column 1, lines 10-11 and column 5, line 66-column 6, line 2).

Therefore, Sotomura does not teach an organosulfur protective layer in a metallic lithium anode, as the Examiner asserts on page 3 of the Office Action. Rather, as stated by the Examiner on page 8 of the Office Action, "The Sotomura et al. reference uses a composite electrode with an organic disulfide fro [sic] a battery which provides high voltage when used with a lithium anode." This statement makes it clear that the organic disulfide is not a part of the metallic lithium anode, but rather is a part of the composite electrode.

In the Advisory Action, the Examiner argues that the organo-sulfur containing composite electrode of Sotomura is doped with lithium ions. However, lithium ions do not constitute a lithium metal layer. As such, the composite electrode of Sotomura does not disclose organosulfur protective layer in a metallic lithium anode and therefore, fails to cure the deficiency of Skotheim.

The Examiner further contends, in both the Office Action and the Advisory Action, that an anode and a cathode become interchangeable in a secondary battery. However, the Examiner applies this assertion incorrectly. Skotheim and Sotomura describe the initial anode and the initial cathode. When the battery is charged or discharged, the charges of the electrodes may change. However, the materials of the electrodes do not change. In both Skotheim and Sotomura, the electrode that is initially negatively charged is referred to as the anode and includes a lithium metal layer, and the electrode that is initially positively charged is referred to as the cathode and does not contain a lithium metal layer. Neither reference discloses the inclusion of an organosulfur compound and an ionic conductive polymer in an electrode comprising a lithium metal layer, as required by independent claims 1 and 24.

3. ZUIHO FAILS TO CURE THE DEFICIENCIES IN SKOTHEIM AND SOTOMURA

Appellants respectfully submit that claim 1 is allowable over Skotheim and Sotomura, and Zuiho fails to cure the deficiencies of Skotheim and Sotomura noted above with regard to claim 1. Hence, claims 8 and 18 are allowable at least because they depend from an allowable claim 1.

4. CHU AND FAUTEUX FAIL TO CURE THE DEFICIENCIES IN SKOTHEIM AND SOTOMURA

Neither Chu nor Fauteux discloses an organosulfur protective layer in a metallic lithium anode. Chu discloses an active-sulfur material in a positive electrode, but provides no such teaching regarding a negative electrode. In the Office Action, the Examiner cited Fauteux for the teaching that an anode and cathode become interchangeable with each other depending on whether the cell is charging or discharging. However, the Examiner once again applied this teaching incorrectly.

Even if the negative electrode of Chu, which comprises a lithium metal layer, becomes the positive electrode, and the positive electrode of Chu, which comprises the active-sulfur material, becomes the negative electrode, one does not arrive at the claimed invention. Rather, in this scenario, the negative electrode comprises an active-sulfur material, but not a lithium metal layer. Therefore, none of the references teach an electrode including both an organosulfur material and a lithium metal layer, as required by independent claim 24.

CONCLUSION

A *prima facie* case of obviousness has not been established because the cited references fail to disclose every feature of the claimed invention. Further, there is no reason that would lead one of ordinary skill in the art to combine or modify the cited references in the manner suggested by the Examiner. Therefore, the pending rejections cannot be allowed to stand.

Respectfully Submitted,

/hae-chan park/

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(viii) CLAIMS APPENDIX

1. (Previously Presented) A negative electrode for a lithium battery, comprising:

a lithium metal layer; and

a protective layer on the lithium metal layer, wherein the protective layer includes an organosulfur compound and an ionic conductive polymer to help facilitate transfer of lithium ions.

2. (Original) The negative electrode of claim 1, wherein the organosulfur compound is a thiol group-containing organosulfur compound.

3. (Original) The negative electrode of claim 1, wherein the organosulfur compound is a monomer, dimer, trimer, oligomer, or a polymer.

4. (Original) The negative electrode of claim 1, wherein the organosulfur compound is selected from the group consisting of 2,5-dimercapto-1,3,4-thiadiazole, bis(2-mercapto-ethyl)ether, N,N'-dimethyl-N,N'-dimercaptoethylene-diamine, N,N,N',N'-tetramercapto-ethylenediamine, polyethyleneimine, polyethyleneimine derivatives, 2,4,6-trimercaptotriazole, N,N'-dimercapto-piperazine, 2,4-dimercaptopyrimidine, 1,2-ethanedithiol, bis(2-mercapto-ethyl)sulfide, and mixtures thereof.

5. (Original) The negative electrode of claim 1, wherein the organosulfur compound is in an amount ranging from about 50 to about 100 wt% of the protective layer.

6. (Original) The negative electrode of claim 1, wherein the protective layer further comprises an electron conductive polymer to provide electron conductivity and for facilitation of cation transfer.

7. (Original) The negative electrode of claim 6, wherein the electron conductive polymer is selected from the group consisting of poly(aniline), poly(p-phenylene), poly(thiophene), poly(3-alkylthiophene), poly(3-alkoxythiophene), poly(crowneherthiophene), poly(pyrrole), poly(N-alkylpyrrole), poly(pyridine), poly(alkylpyridine), poly(2,2'-bipyridine), poly(dialkyl-2,2'-bipyridine), poly(pyrimidine), poly(dihydrophenanthrene), poly(quinoline), poly(isoquinoline), poly(1,2,3-benzothiadiazole), poly(benzimidiazole), poly(quinoxaline), poly(2,3-diarylquinoxaline), poly(1,5-naphthyridine), poly(1,3-cyclohexadiene), poly(anthraquinone), poly(Z-methylanthraquinone), poly(ferrocene), and poly(6,6'-biquinoline).

8. (Original) The negative electrode of claim 6, wherein the electron conductive polymer is an emeraldine base polymer.

9. (Original) The negative electrode of claim 6, wherein the electron conductive polymer is a doped polymer.

10. (Original) The negative electrode of claim 9, wherein the doped polymer is prepared by reaction with a doping material, the doping material being selected from the group consisting of a halogen, a Lewis acid, a proton acid, a transition metal compound, an electrolytic anion, a sulfonic acid, O_2, $XeOF_4(NO_2^+)(SbF_6^-)$, $(NO_2^+)(SbCl_6^-)$, $(NO_2^+)(BF_4^-)$, FSO_2OOSO_2F, $AgClO_4$, H_2IrCl_6, and $La(NO_3)_3 \cdot 6H_2O$.

11. (Original) The negative electrode of claim 9, wherein the doped polymer is prepared by reaction with a doping material, the doping material being a halogen selected from the group consisting of Cl_2, Br_2, I_2, ICl, ICl_3, IBr, and IF.

12. (Original) The negative electrode of claim 9, wherein the doped polymer is prepared by reaction with a doping material, the doping material being a Lewis acid selected from the group consisting of PF_5, AsF_5, SbF_5, BF_3, BCl_3, BBr_3, and $SO_{3.}$

13. (Original) The negative electrode of claim 9, wherein the doped polymer is prepared by reaction with a doping material, the doping material being a proton acid selected from the group consisting of HF, HCl, HNO_3, H_2SO_4, $HClO_4$, FSO_3H, $ClSO_3H$, CF_3SO_3H, and an amino acid.

14. (Original) The negative electrode of claim 9, wherein the doped polymer is prepared by reaction with a doping material, the doping material being a transition metal compound selected from the group consisting of $FeCl_3$, FeOCl, $TiCl_4$, $ZrCl_4$, $HFCl_4$, NbF_5, $NbCl_5$, $TaCl_5$, MoF_5, WF_6, WCl_6, UF_6, and $LnCl_3$ (Ln=lanthanoide)

15. (Original) The negative electrode of claim 9, wherein the doped polymer is prepared by reaction with a doping material, the doping material being an electrolytic anion selected from the group consisting of Cl^-, Br^-, I^-, Cl_4^-, PF_6^-, AsF_6^-, SbF_6^-, and $BF_{4.}$

16. (Original) The negative electrode of claim 9, wherein the doped polymer is prepared by reaction with a doping material, the doping material being a sulfonic acid having the formula $R\text{-}SO_3H$, where R is selected from the group consisting of a C_1 to C_{12} alkyl, a C_6 to C_{12} aryl, and an aralkyl group.

17. (Original) The negative electrode of claim 9, wherein the doped polymer is prepared by reaction with a doping material, the doping material being selected from the group consisting of doceyl benzene sulfonic acid, p-toluene sulfonic acid, benzene sulfonic acid, and octylbenzene sulfonic acid.

18. (Original) The negative electrode of claim 6, wherein the electron conductive polymer is a polymer having a doping ratio of at least about 30%.

19. (Previously Presented) The negative electrode of claim 6, wherein the electron conductive polymer is added in the protective layer in an amount of about 40 wt% or less of the protective layer.

20. (Cancelled)

21. (Previously Presented) The negative electrode of claim 1, wherein the ionic conductive polymer is selected from the group consisting of poly(ethyleneoxide), poly(propyleneoxide), poly(ethylenesuccinate), poly(ethyleneadipate), poly(ethyleneimine), poly(epichlorohydrin), poly(β-propiolactone), poly(N-propylaziridine), poly(alkylenesulphide) where the alkylene is a C_2 to C_6 aliphatic hydrocarbon, poly(ethyleneglycoldiacrylate), poly(prophyleneglycoldiacrylate), poly(ethyleneglycoldimethacrylate), and poly(prophyleneglycoldimethacrylate).

22. (Original) The negative electrode of claim 21, wherein the ionic conductive polymer has a weight average molecular weight ranging from about 10,000 to about 600,000.

23. (Previously Presented) The negative electrode of claim 1, wherein the ionic conductive polymer is added in the protective layer at an amount of about 30 wt% or less.

24. (Original) A negative electrode for a lithium battery, comprising:

a lithium metal layer; and

a protective layer on the lithium metal layer, wherein the protective layer includes an organosulfur compound, an electron conductive polymer, and an ionic conductive polymer.

25. (Original) The negative electrode of claim 24, wherein the protective layer comprises the organosulfur compound in an amount ranging from about 50 to about 70 wt%, the electron conductive polymer in an amount ranging from about 20 to about 40 wt%, and the ionic conductive polymer in an amount ranging from about 10 to about 30 wt% of the protective layer.

26. (Withdrawn) A method for fabricating a negative electrode for a lithium battery, the method comprising the steps of:

adding an organosulfur compound to a solvent to prepare a slurry; and

coating the slurry on lithium metal to form an organosulfur compound-containing layer.

27. (Withdrawn) The method for fabricating a negative electrode of claim 26 further comprising the step of adding an electron conductive polymer and an ionic conductive polymer to the solvent.

28. (Withdrawn) The method for fabricating a negative electrode of claim 27, wherein the electron conductive polymer is selected from the group consisting of poly(aniline), poly(p-phenylene), poly(thiophene), poly(3-alkylthiophene), poly(3-alkoxythiophene), poly(crowneherthiophene), poly(pyrrole), poly(N-alkylpyrrole), poly(pyridine), poly(alkylpyridine),

poly(2,2'-bipyridine), poly(dialkyl-2,2'-bipyridine), poly(pyrimidine), poly(dihydrophenanthrene), poly(quinoline), poly(isoquinoline), poly(1,2,3-benzothiadiazole), poly(benzimidiazole), poly(quinoxaline), poly(2,3-diarylquinoxaline), poly(1,5-naphthyridine), poly(1,3-cyclohexadiene), poly(anthraquinone), poly(Z-methylanthraquinone), poly(ferrocene), and poly(6,6'-biquinoline).

29. (Withdrawn) The method for fabricating a negative electrode of claim 27, wherein the ionic conductive polymer is selected from the group consisting of poly(ethyleneoxide), poly(propyleneoxide), poly(ethylenesuccinate), poly(ethyleneadipate), poly(ethyleneimine), poly(epichlorohydrin), poly(β-propiolactone), poly(N-propylaziridine), poly(alkylenesulphide) poly(ethyleneglycoldiacrylate), poly(prophyleneglycoldiacrylate), poly(ethyleneglycoldimethacrylate), and poly(prophyleneglycoldimethacrylate).

30. (Withdrawn) The method for fabricating a negative electrode of claim 27 further comprising the step of adding a cross-linking initiator selected from the group consisting of diacyl peroxide dialkyl, peroxide peroxy ester, tertiary alkyl hydroperoxide, peroxy ketal, peroxydicarbonate, and an azo compound where the ionic conductive polymer is an acrylate-based polymer.

31. (Withdrawn) The method for fabricating a negative electrode of claim 27, further comprising the step of adding a cross-linking initiator selected from the group consisting of dibenzoyl peroxide, succinic acid peroxide, dilauroyl peroxide, didecanoyl peroxide, dicumyl peroxide, di-t-butyl peroxide, 2,5-dimethyl-2,5-di-(t-butylperoxy)hexane, α-cumyl peroxy neodecanoate, 1,1-dimethyl-3-hydroxybutyl peroxy-2-ethyl hexanoate, t-amylperoxy benzoate, t-butyl peroxy pivalate, 2,5-dihydroperoxy-2,5 -dimethylhexane, cumene hydroperoxide, t-butyl hydroperoxide, 1,1-di-(t-amylperoxy)- cyclohexane, 2,2-di-(t-butyl peroxy)butane, ethyl 3,3-di-(t-

butylperoxy)-butylate, di(n-propyl) peroxy-dicarbonate, di(sec-butyl) peroxy- dicarbonate, di(2-ethyl hexyl)peroxy-dicarbonate, and azobis isobutyronitrile.

32. (Withdrawn) The method for fabricating a negative electrode of claim 27, wherein the ionic conductive polymer is an acrylate-based polymer, and wherein the slurry further comprises a cross-linking facilitator.

33. (Withdrawn) The method for fabricating a negative electrode of claim 32, wherein the cross-linking facilitator is selected from the group consisting of triethylamine, tributylamine, riethanol amine, and N-benzyldimethyl amine.

34. (Withdrawn) A method for fabricating a negative electrode for a lithium battery, comprising the steps of:

adding an organosulfur compound to a positive electrode; and

performing at least one charge and discharge cycle for the battery having a negative electrode, thereby forming a protective layer on a negative.

35. (Withdrawn) A lithium battery, comprising

a positive electrode including a positive active material selected from the group consisting of a lithium-containing metal oxide, a lithium-containing calcogenide, a sulfur-based material, and a conductive polymer;

a negative electrode comprising a lithium metal layer, and a protective layer on the lithium metal layer, wherein the protective layer includes an organosulfur compound; and

an electrolyte between the positive and negative electrodes.

36. (Withdrawn) The lithium battery of claim 35, wherein the lithium battery is a lithium primary battery.

37. (Withdrawn) The lithium battery of claim 35, wherein the lithium battery is a lithium secondary battery.

38. (Withdrawn) The lithium battery of claim 35, wherein the electrolyte comprises a mixed organic solvent of 1,3-dioxolane, diglyme, sulforane, and dimethoxyethane.

(ix) <u>EVIDENCE APPENDIX</u>

No Evidence is submitted in this Brief.

(x) RELATED PROCEEDINGS APPENDIX

Upon information and belief of counsel, appellants and the assignee of record are not aware of any pending appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal. Consequently, this Appendix is empty.